Section 3 - Conceptual Foundation of Quantum Tunneling in CUWF

Quantum tunneling has long stood as one of the most conceptually puzzling predictions of quantum mechanics: a phenomenon in which a particle appears on the far side of a barrier without following any classically admissible path through the intervening region. Although standard quantum mechanics predicts tunneling probabilities with great mathematical success, it does not provide a physical mechanism explaining how such an event occurs, why no stable particle detection is obtained inside the barrier, or why tunneling-time observables display paradoxical behavior.

The Chayut Universe Wave Function (CUWF) addresses this problem by recasting tunneling within a deterministic wave-geometric framework grounded in structural entropy and collapse-node dynamics. In CUWF, the fundamental entity is not a persisting particle but a continuous wave defined on the Fundamental Wave Basin (FWB). What is ordinarily called a 'particle' is instead a collapse node: a temporary, localized stabilization of the underlying wave at an entropic minimum. Tunneling therefore is not the traversal of a durable object through a forbidden region, but a structural reconfiguration of wave-node relations across an entropic barrier.

At the conceptual core of this framework lie three principles. First, waves are continuous: the underlying wave never breaks, vanishes, or loses continuity on the FWB. Second, particles are discontinuous: a particle is only a collapse node, not an enduring object with intrinsic continuity. Third, tunneling is not traversal: Node A destabilizes as the entropic landscape becomes unfavorable, the wave continues through the barrier without a stable node, and Node B appears at the next admissible entropic minimum. Standard quantum mechanics describes the probability of such outcomes; CUWF seeks to specify the physical mechanism that generates them.

3.1 The CUWF Interpretation of a Particle: Collapse Node, Not Object

In conventional physics, a particle is typically represented as an entity possessing position, trajectory, and persistent identity. CUWF adopts a different ontology. A particle is a collapse node, denoted N(x,t), formed only where the structural entropy field admits a local minimum satisfying

$$dS(x)/dx = 0$$

$$d^2S(x)/dx^2 > 0$$

These conditions define the local geometric stability required for node formation. A collapse node has no intrinsic continuity of its own; continuity resides only in the underlying wave. Accordingly, a node may appear, disappear, and reappear elsewhere without violating continuity, because it is the wave - not the node - that persists. This conceptual shift removes the need to imagine a particle as a miniature object physically passing through a barrier.

3.2 A Barrier as an Entropic Peak, Not a Potential Wall

In standard quantum mechanics, a barrier is represented by a potential function V(x). CUWF instead interprets the barrier as a region of elevated structural entropy within the composite wavefield. In its simplest form, the barrier condition may be expressed as

$$S_{inside} > S_{before}$$

This means that the barrier is not fundamentally a location of high potential but a region in which the local wave structure becomes unfavorable for node stability. Destructive interference, resonance mismatch, and geometric distortion of the waveform together produce an entropic peak rather than a traversable wall. The essential point is therefore not that a particle penetrates the barrier, but that the wave can no longer sustain a collapse node within it.

3.3 Why Node A Must Collapse at the Barrier

As the incoming wave enters the barrier region, the structural entropy rises and the curvature of the entropic landscape ceases to support a stable minimum. In one-dimensional form, the barrier interior satisfies

$$d^2S_{inside}/dx^2 < 0$$

This corresponds to an entropic hill rather than an entropic well. Node A therefore becomes unstable and must collapse. This collapse is not treated as a probabilistic accident; it is a deterministic consequence of the local entropic geometry. The wave, however, remains continuous on the FWB and therefore survives the collapse of the node.

3.4 What Happens Beyond the Barrier: Formation of Node B

If the post-barrier wavefield contains a new entropic minimum, the wave can stabilize again into a new collapse node. The post-barrier condition is

$$dS_{after}/dx = 0$$

$$d^2S_{after}/dx^2 > 0$$

Under these conditions, the continuous wave re-instantiates as a new node,

$$N_B = \text{collapse at the next entropic minimum}$$

Node B is not Node A after transport through space. It is the next valid local realization of the same continuous wave. This immediately dissolves the standard traversal picture and replaces it with a three-phase structure: node destabilization, wave-only continuity, and node re-instantiation.

3.5 Why CUWF Provides a Physical Mechanism

Standard quantum mechanics provides transmission amplitudes and successful probability calculations, but it does not specify what physically occurs during tunneling. It does not explain why the particle is never stably observed inside the barrier, why tunneling-time observables resist classical interpretation, or why apparent particle identity seems preserved despite the absence of a continuous trajectory. CUWF addresses these questions by locating continuity in the wave rather than in the particle and by interpreting tunneling as a geometric-entropic restructuring rather than as motion through a forbidden region.

In this view, tunneling is described conceptually as

Node A -> wave-only continuity through the barrier -> Node B

or, in more explicit structural terms,

node destabilization -> wave-only propagation -> node re-instantiation

This framework supplies a physical narrative that is both conceptually coherent and mathematically preparatory for the more detailed developments in the following sections.

3.6 Summary

Section 3 has established the conceptual foundations of tunneling in the CUWF framework. A particle is a collapse node rather than a persisting object. A barrier is a region of elevated structural entropy rather than a wall to be crossed. Tunneling is not passage through the barrier interior, but a three-phase process in which node stability is lost, the wave continues without a stable node, and a new node forms beyond the barrier where the entropic geometry again permits collapse. These principles prepare the way for Section 4, which formalizes the barrier itself as a region of entropic instability and develops the mathematical basis of node collapse in greater detail.